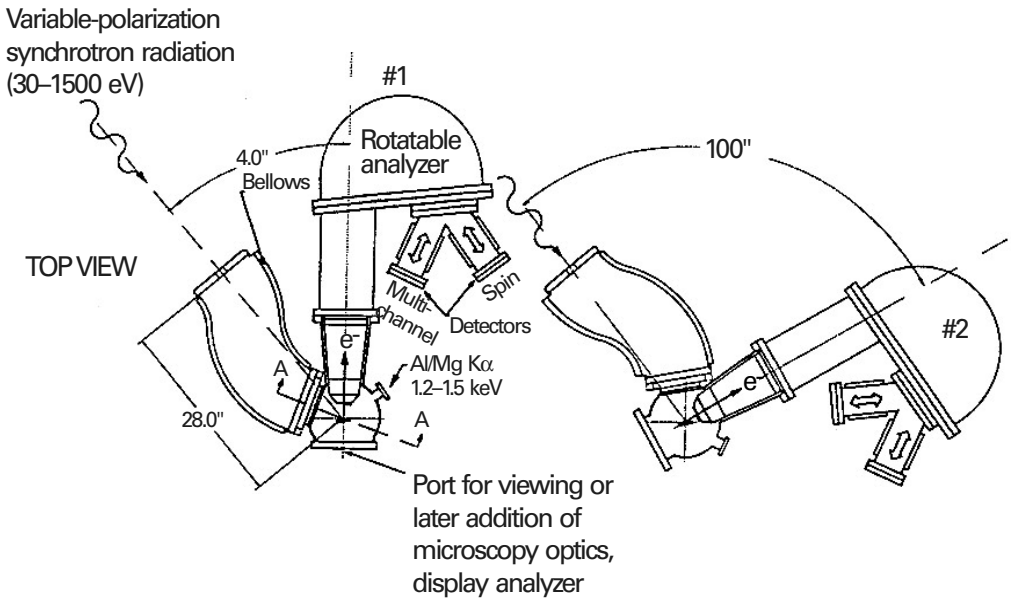
Advanced Photoelectron Spectrometer/ Diffractometer (APSD) • Beamline 9.3.2

Berkeley Lab • University of California

APSD Specifications

Kinetic Energy Range (eV)	Energy Resolution (E/ΔE)	Angular Resolution (deg)	Spot Size (mm)	Polarization	Sample	Availability
2–1500	**10,000** (with retardation of 10)	**±1.5 or ±6.0**	**0.5×1**	**Linear or Circular** (selectable with movable aperture)	**UHV-Compatible Solids** (up to10 mm diameter, 1–2 mm thick)	**NOW**



Schematic layout *of the APSD showing angular range of the rotatable sample chamber and energy analyzer.*

Beamline 9.3.2 serves two experimental stations mounted on a platform that rotates so that the two stations can share beam without breaking vacuum. Permanently installed on the platform, the advanced photoelectron spectrometer/ diffractometer (APSD) has an angle-resolving electron-energy analyzer for high-resolution photoelectron spectroscopy, diffraction, and holography of surfaces with linearly and circularly polarized synchrotron radiation. An applied materials chamber, an angle-resolved photoelectron spectroscopy chamber, or an independent user chamber may be installed in the second location.

The hemispherical electron-energy analyzer is a large-diameter Scienta ES200 with a tunable energy resolution up to 1 part in 10,000 (using redardation by a factor of 10). The control software for this analyzer has been completely rewritten for greater flexibility. The analyzer is incorporated into the main sample chamber, which can rotate 60 degrees in the plane of the storage ring by means of a large-diameter bellows linking the chamber to the beamline. This geometry permits measurements of photoelectron angular distributions over a large fraction of the 2π solid angle above the surface while keeping the photon beam/sample orientation fixed. A

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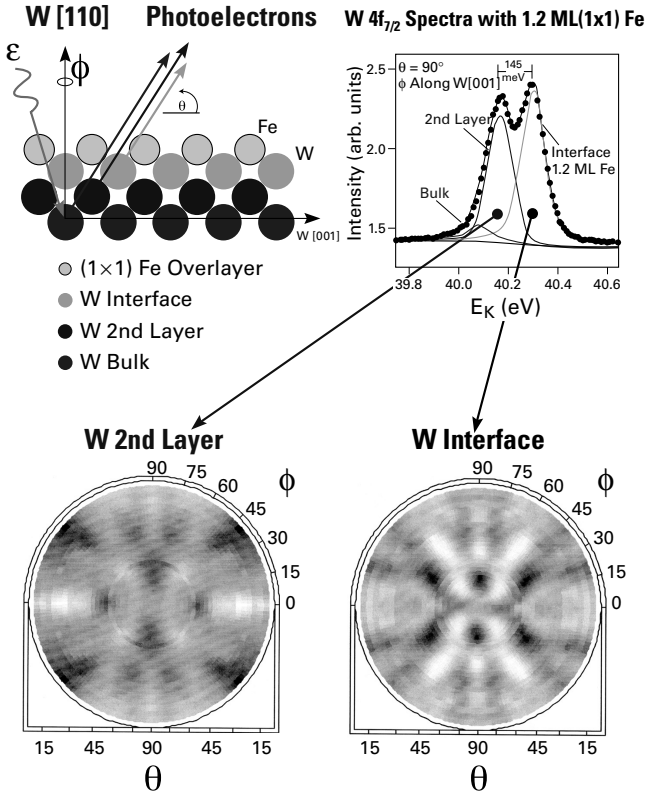
demountable collimator also permits limiting the solid angle of acceptance to ±1.5° for measurements with high angular resolution. Either a multichannel detector or micro-Mott detector for spin resolution may be used via a rotatable detector carousel. During 2000, an ultrahigh-speed multichannel detector, operating at up to ~1 GHz, and a high-resolution soft x-ray emission spectrometer (Gammadata/Scienta XES 300) will also be installed on the APSD.

Separated from the main chamber by a gate valve, a sample preparation and characterization chamber incorporates a LEED system, an ion sputtering gun, Knudsen cells for metal deposition, a quartz-crystal oscillator for monitoring growth, and a large-gap *in-situ* magnet for magnetizing samples and carrying out surface magneto-optical Kerr effect (SMOKE) measurements. A precision long-travel sample goniometer with computer control of both polar and azimuthal motions with about ± 0.3% accuracy translates samples between the two chambers and permits automated scanning of angle-resolved photoelectron spectra.

The system can accommodate up to eight samples on a carousel with in-situ transfer to the measurement position via wobble stick. A load-lock also permits inserting up to four samples from air and into full UHV in ~6–8 hours. Samples can be heated inductively, resistively, or with electron bombardment (up to 2300 K in the last case) or cooled to 200 K with liquid nitrogen. The main sample chamber is also equipped with an AlKα/MgKα x-ray source for off-line quantitative analysis and photoelectron diffraction, as well as a low-energy electron flood gun for charge neutralization of insulating samples.

The APSD will also be used on Beamline 4.0.1-2. ■



Photoelectron diffraction *gives the atomic geometry of a monolayer of iron deposited on a tungsten(110) surface. The XPS spectrum for tungsten 4f electrons has three primary components: a peak due to atoms at the iron-tungsten interface, a peak due to next-neighbor atoms in the second layer below the iron, and a weak feature due to deeper atoms. Comparison of experimental diffraction patterns, such as those shown for interfacial and next-neighbor atoms, with diffraction patterns calculated for candidate structures, shows that the iron sits in a bridge site 2.16 Å above the interfacial tungsten atoms. Data courtesy of E. Tober (IBM Almaden Research Center); F.J. Palomares (ICMM-CSIC, Madrid); and R. Ynzunza, Z. Wang, and C.S. Fadley (University of California at Davis and LBNL) [Phys. Rev. Lett. 29, 2085 (1997)].*

To obtain a proposal form, go to www-als.lbl.gov/als/quickguide/independinvest.html.

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